



Amendment under 37 C.F.R. § 1.111
U.S. Application No. 10/516,455

Attorney Docket No. Q84452

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (currently amended) A method of etching a substrate ~~(16)~~ by an inductively-coupled plasma ~~(24)~~, the method comprising:

placing in which the substrate ~~(16)~~ ~~is placed~~ in a reaction chamber ~~(1)~~;

establishing an atmosphere of an appropriate gas ~~is established~~ in the reaction chamber ~~(1)~~ at a suitable operating pressure;

biasing the substrate; ~~(16)~~ ~~is biased~~, and

exciting the gas in the reaction chamber ~~(1)~~ ~~is excited~~ by a radiofrequency excitation electromagnetic wave passing through a leakproof wall ~~(5)~~ of dielectric material in order to generate a plasma ~~(24)~~, ~~which method is characterized in wherein~~ the method further comprises:

~~that it includes a prior step of~~ establishing the power of ~~the~~ plasma excitation electromagnetic wave progressively, ~~during which step wherein~~ a gas that is inert for the substrate is injected into the reaction chamber ~~(1)~~ and the power of the plasma excitation electromagnetic wave is raised progressively until the appropriate nominal power is reached, thereby forming an inert gas plasma ~~(24)~~ which progressively heats up the leakproof wall ~~(5)~~ of dielectric material, and

~~after which injecting an~~ active gas ~~is injected~~ into the reaction chamber ~~(1)~~ in order to replace the inert gas and ~~undertake active steps of perform~~ etching by ~~means of~~ the plasma ~~(24)~~ of the active gas.

2. (currently amended) A method according to claim 1, ~~characterized in that~~ wherein the progressive increase in the plasma excitation power is programmed so as to ensure that the thermal shock applied to the leakproof wall (5) of dielectric material by the inert gas plasma (24) remains below a wall-destroying threshold.

3. (currently amended): A method according ~~got to~~ to claim 1, ~~characterized in that~~ wherein the ~~prior step of~~ progressively establishing the plasma excitation power is undertaken solely at the beginning of reaction chamber operation after a period of inactivity, and is followed by alternating active etching ~~steps (BC; CD)~~ during which the temperature of the leakproof wall (5) of dielectric material remains in a range of values that is sufficiently narrow to avoid any destructive thermal shock being applied to the leakproof wall (5) of dielectric material.

4. (currently amended): A method according to claim 1, ~~characterized in that~~ wherein the active etching ~~steps comprise~~ comprises a succession of etching ~~steps-periods (BC)~~ using a fluorine-containing gas ~~such as SF₆~~, and passivation ~~steps-period (CD)~~ using ~~a of an~~ etching passivation gas ~~such as C_xF_y~~.

5. (currently amended) Apparatus for etching substrates (16) ~~by~~ an inductively-coupled plasma, the apparatus implementing a method according to any one of claims 1 to 4, and comprising

a reaction chamber ~~(1)~~ surrounded by a leakproof wall ~~(2)~~, ~~the reaction chamber (1)~~ having substrate support means ~~(3)~~ and being in communication with an inductively-coupled plasma source ~~(4)~~ having a leakproof wall ~~(5)~~ of dielectric material, and

an inductive coupling antenna ~~(6)~~ powered by a radiofrequency generator ~~(7)~~, the

wherein the reaction chamber ~~(1)~~ being is connected via a vacuum line ~~(8)~~ to pump means ~~(9)~~ for establishing and maintaining an appropriate vacuum inside the reaction chamber ~~(1)~~, and

the reaction chamber ~~(1)~~ being is connected via an inlet line ~~(10)~~ to a process gas source ~~(11)~~, wherein the apparatus being characterized in that further comprises:

the process gas source ~~(11)~~ comprises an inert gas source ~~(11a)~~, at least one active gas source ~~(11b, 11e)~~, and distribution means ~~(12a, 12b, 12e)~~ controlled by control means ~~(13)~~ to introduce the appropriate gas into the reaction chamber ~~(1)~~;

the radiofrequency generator ~~(7)~~ has means for adjusting its radiofrequency power under the control of the control means ~~(13)~~; and

the control means ~~(13)~~ include includes a control program ~~(13a)~~ with a prior sequence of establishing power, during which:

a) the control means ~~(13)~~ control controls the distribution means ~~(12a, 12b, 12e)~~ to introduce an inert gas into the reaction chamber ~~(1)~~;

b) the control means ~~(13)~~ cause causes the radiofrequency power control means of the radiofrequency generator ~~(7)~~ to produce radiofrequency energy that increases progressively until reaching the nominal power ~~(PN)~~; and

c) ~~thereafter~~ the control means ~~(13) control~~ controls the distribution means ~~(12a, 12b, 12c)~~ to replace the neutral gas in the reaction chamber ~~(1)~~ with an active gas.

6. (currently amended): ~~The Apparatus~~ apparatus according to claim 5, ~~characterized in that wherein~~ the distribution means ~~(12a, 12b, 12c) comprise~~ comprises solenoid valves each connected in series between a respective corresponding gas source outlet ~~(11a, 11b, 1c)~~ and an inlet ~~(14)~~ to the plasma source ~~(4)~~.

7. (currently amended): ~~The Apparatus~~ apparatus according to claim 5, ~~characterized in that it includes~~ further comprising a source ~~(11a)~~ of inert gas ~~such as nitrogen (N₂) or argon~~, a source ~~(11b)~~ of an etching gas ~~such as SF₆~~, and a source ~~(11c)~~ of a passivation gas ~~such as C₄F₈~~.

8. (currently amended): ~~The Apparatus~~ apparatus according to claim 5, ~~characterized in that wherein~~ the leakproof wall ~~(5)~~ of dielectric material of the plasma source ~~(4)~~ is made of alumina Al₂O₃.

9. (currently amended): ~~The Apparatus~~ apparatus according to claim 5, ~~characterized in that wherein~~ the leakproof wall ~~(5)~~ of dielectric material of the plasma source ~~(4)~~ is of tubular shape, and the inductive coupling antenna ~~(6)~~ is a coaxial turn placed around the tubular wall.

10. (currently amended): ~~The Apparatus~~apparatus according to claim 5, ~~characterized in that wherein~~ the leakproof wall (2) of the reaction chamber (1) ~~has~~comprises a peripheral portion (2a) connected to an inlet front portion (2b) that is ~~itself~~ open to communicate with an inlet tube constituting the plasma source (4), wherein the inlet front portion (2b) ~~being~~is connected to the leakproof wall (5) of dielectric material by means of a sealing gasket (2e), together with cooling means (2d) for cooling the inlet front portion (2b) and the sealing gasket (2e).